U.S. DEPARTMENT OF ENERGY | Nuclear Energy

Nuclear Energy University Programs (NEUP) Fiscal Year (FY) 2013 Annual Planning Webinar

Integrated Research Program in Nano-Nuclear Technology

C. Bolton

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Nano-Nuclear Background

- Nano science ushered in during 1980's
- Exciting potential of nano science and technology leads to government wide nano initiative in 1990's
- Office of Science a major player in developing the basic nano science
- Office of Nuclear Energy organizes (5/2012) a broadly based workshop to explore the possible uses of nano technology in nuclear
- General conclusion of the workshop was that nano nuclear research done with multi-disciplinary teams offered exciting potentials for advancing the state of art of nuclear power

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Imagine The Possibilities

- Shielding materials that are more effective yet significantly lighter and thinner.
- Structural materials that require less than half the weight of current materials yet achieve superior strength.
- Materials immune to the effects of radiation.
- Fuels that can last the life of the reactor and robust enough to withstand beyond design basis accidents.
- Instruments that measure component, fuel, and equipment performance, in situ, ensuring against failure and optimizing performance.
- Sensors that can detect atoms of materials of interest
- Being able to selectively remove fission products from waste streams so as to radically minimize the volumes of waste requiring treatment and disposal.

NE Viewpoint on Nano-Nuclear

- **Nano nuclear offers exciting possibilities for advancing nuclear energy in the areas of:**
  - Mechanical
  - Chemical
  - Physical

Mechanical

- **Potential Applications**
  - Structural Materials
  - Coatings and Barriers
  - Material Sensors and In-service Monitors
  - Composite/Hybrid Materials (including concretes)

Chemical

- **Potential Applications**
  - Fission Gas Capture
  - Separation of fission products and/or fissionable material
  - Uranium from seawater separation
  - Fuel design for fission product release
  - Sensors and on line monitoring
  - Coatings for corrosion control

Physics/Thermo-hydraulic

Potential Applications

- Improved heat transfer and fluid flow of current and advanced reactors
- Improved thermal conductivity, fission gas and fission product retention, and reduced cladding mechanical interaction in uranium-oxide fuels
- Improved performance and fabrication of advanced fuels
- Improved shielding
- In-situ sensors

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IRP and New Capabilities

- Research requires integrated teams (merging the distinctly different nano-science and nuclear engineering communities) because of the close connection to basic research and because of the interaction with many systems
- The integrated and exploratory nature of this work makes it an ideal candidate for an NEUP Integrated Research Project (IRP)
- NE is requesting proposals for at most a single nano nuclear IRP
- An IRP requires focused research aimed a developing a new capability
- Because of the exploratory nature of the research, the definition of the new capability is left up to the proposer. The proposal should contain an explanation the value of this new capability
- Part of the review criteria will be the perceived value of the new capability

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Nano-Nuclear IRP Summary

- Nano nuclear research is still exploratory in nature, but it is perceived to offer significant opportunities to advance nuclear energy
- Because of the significant basic research that has already been done in nano science, and because of the multiple interaction systems in nuclear energy, the research is best conducted by an multi-disciplinary integrated team
- The Department is calling for proposals for a three-year IRP in the area of nano nuclear technology as part of its NEUP program